

REMARKS

Claims 1, 22, 26, and 31 are cancelled, claims 2-4, 7, 11, 13, 14, 17-21, 23-25, 27, 29, 32, 34, and 35 are amended, and claims 36-44 are added herein. Claims 2-21, 23-25, 27-30, and 32-44 will be pending upon entry of this Amendment. Applicant notes with appreciation that claim 2 was indicated as being allowable if rewritten in independent form incorporating the limitations of its base claim.

The drawings and specification have been amended herein to more fully describe the embodiment shown in the drawings. No new matter is believed to be added by these amendments.

I. Claim 36

The present invention is directed to an electrical circuit assembly comprising an integrated circuit device (e.g., a microchip) in electrical and mechanical connection with a chip carrier substrate (e.g., printed circuit board or test substrate) via the interengagement of at least one electrically conductive connecting element with a socket. The electrical circuit assembly of the present invention allows the integrated circuit device to be easily removed from the substrate without the need for time consuming and costly rework of the chip connection pads. Also, the electrical circuit assembly of the present invention allows a reconnectable chip interface without the need for an intervening connector between the integrated circuit device and the substrate.

More specifically, claim 36 recites an electrical circuit assembly comprising:

- a substrate having a first electrical connection pad;
- an integrated circuit device having a second electrical connection pad;

- at least one electrically conductive connecting element attached to one of said first and second connection pads prior to assembly of the substrate and the integrated circuit device;

IN THE DRAWINGS

Attached are two (2) replacement sheets of drawings that include amendments to Figures 3 and 3A.

Figures 3 and 3A have been amended to add reference numbers 49a and 49b to identify the pad connection portion for each resilient member 43a, 43b of each socket 35.

at least one socket comprising at least two resilient members attached to the other of said first and second connection pads prior to assembly of the substrate and the integrated circuit device;

said at least one socket being adapted to receive said at least one electrically conductive connecting element when the substrate and integrated circuit device are assembled such that the at least two resilient members of the socket exert a biasing force against said at least one electrically conductive connecting element to hold the substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device, said assembly being free of any containment structure between the substrate and the integrated circuit device surrounding the at least two resilient members.

New claim 36 is submitted to be unanticipated by and patentable over the references of record, and in particular U.S. Patent Nos. 5,046,972 (Pass) and 5,746,608 (Taylor), in that whether considered alone or in combination the references fail to show or suggest an electrical circuit assembly having all of the features recited in new claim 36.

Pass discloses an assembly 10 including a pin grid array or package 12 including an integrated circuit device 14 and an array of pins 16 projecting therefrom for insertion into a connector 20. The connector 20 is a dielectric block 22 containing a grid of apertures 24 in a grid array matching the array of pins 16 on the package 12. Each aperture 24 of the connector 20 contains a socket contact 40 having a pair of spring arms 58, 60 that receive the pins in a mated condition of the package 12 and connector 20. Each socket 40 has arms 58, 60 housed in a respective cavity 29 of the connector 20 and a pin 42 that extends from the connector for connection to circuit traces of the printed circuit board (not shown) by soldering. The

connector 20 intervenes between the package 12 containing the circuit device 14 and the printed circuit board to facilitate the functioning of the package as part of an electrical circuit assembly.

Pass fails to show or suggest an electrical circuit assembly having a socket that exerts a biasing force against the electrically conductive connecting element to hold a substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device. Also, Pass fails to show or suggest an electrical circuit assembly that is free of any containment structure between the substrate and the integrated circuit device surrounding the at least two resilient members of the socket.

In contrast to the assembly set forth in claim 36, Pass teaches that the sockets 40 are contained in the connector 20 that is separate from the integrated circuit device 14 and the substrate (printed circuit board). Also, Pass discloses that the connector 20 has respective cavities 29 that house and surround the resilient members 58, 60 of each socket 40 of the assembly.

For these reasons, new claim 36 is unanticipated and patentable over Pass.

Taylor discloses a socket 6 for interconnecting an electronic package 2 to a circuit board 8. The socket 6 includes a housing 10 having a top surface 12 that receives the package 2 and a bottom surface 14 that opposes the circuit board 8. The housing 10 has cavities 18 with diametrically opposed slots or channels 19 that hold a respective contact 20. Each contact 20 has spaced apart arms 42 housed in a respective cavity 18 that receive a respective lead 4 of the package 2. Each contact 20 has a surface mount section 50 with a convex bottom surface 52 for soldering to a circuit board.

Taylor fails to show or suggest an electrical circuit assembly having a socket that exerts a biasing force against the

electrically conductive connecting element to hold a substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device. Also, Taylor fails to show or suggest an electrical circuit assembly that is free of any containment structure between the substrate and the integrated circuit device surrounding the at least two resilient members.

In contrast to the assembly set forth in claim 36, Taylor teaches that the contacts 20 are contained in the housing 10 of the socket 6 which is separate from the package 2 and the circuit board 8. Also, Taylor discloses that the housing 10 has cavities 18 that contain and surround the arms 42 of each contact 20.

For these reasons, new claim 36 is unanticipated and patentable over Taylor.

The other references of record also fail to show or suggest all of the features of new claim 36.

Claims 2-21 now depend directly or indirectly from new claim 36 and are submitted to be patentable over the references of record for the same reasons as claim 36.

II. Claim 37

New claim 37 is similar in scope as claim 36 but recites that the electrical conductive connecting element comprises a body having a headless free end. More specifically, new claim 37 is directed to an electrical circuit assembly comprising:

- a substrate having a first electrical connection pad;
- an integrated circuit device having a second electrical connection pad;

- at least one socket attached to one of said first and second connection pads prior to assembly of the substrate and the integrated circuit device;

at least one electrically conductive connecting element attached to the other of said first and second connection pads prior to assembly of the substrate and the integrated circuit device;

said at least one electrically conductive connecting element being received in said at least one socket when the substrate and integrated circuit device are assembled such that the socket exerts a biasing force against said body to hold the substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device, said assembly being free of any containment structure between the substrate and the integrated circuit device surrounding the at least one socket.

New claim 37 is submitted to be unanticipated by and patentable over the references of record, and in particular Pass, in that whether considered alone or in combination the references fail to show or suggest an electrical circuit assembly having all of the features recited in new claim 37.

As stated above for claim 36, Pass discloses a connector 20 that intervenes between the package 12 containing the circuit device 14 and the printed circuit board. The connector 20 houses sockets 40 in a respective cavity 29 of the connector 20.

Pass fails to show or suggest an electrical circuit assembly having a socket that exerts a biasing force against the electrically conductive connecting element to hold a substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device. Also, Pass fails to show or suggest an electrical circuit assembly that is free of any containment structure between the substrate and the integrated circuit device surrounding the at least one socket.

For these reasons, new claim 37 is unanticipated and patentable over Pass and the other references of record.

Claims 23-25 now depend directly or indirectly from new claim 37 and are submitted to be patentable over the references of record for the same reasons as claim 37.

III. Claim 38

New claim 38 is similar in scope as claim 36 but recites that the electrical conductive connecting element comprises a body having an axial surface and at least one shoulder extending from the axial surface that is received in the socket. More specifically, new claim 38 is directed to an electrical circuit assembly comprising:

- a substrate having a first electrical connection pad;
- an integrated circuit device having a second electrical connection pad;

- at least one socket attached to one of said first and second connection pads prior to assembly of the substrate and the integrated circuit device;

- at least one electrically conductive connecting element attached to the other of said first and second connection pads prior to assembly of the substrate and the integrated circuit device, the connecting element comprising a body having an axial surface and at least one shoulder extending from the axial surface;

- said at least one electrically conductive connecting element being received in said at least one socket when the substrate and integrated circuit device are assembled such that the socket exerts a biasing force against said at least one shoulder to hold the substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device, said assembly being free of any containment structure between the substrate and the integrated circuit device surrounding the at least one socket.

New claim 38 is submitted to be unanticipated by and patentable over the references of record, and in particular Taylor in view of U.S. Patent No. 6,492,737 (Imasu et al.), in that whether considered alone or in combination the references fail to show or suggest an electrical circuit assembly having all of the features recited in new claim 38.

As set forth above for claim 36, Taylor discloses a socket 6 comprising a housing 10 for interconnecting an electronic package 2 to a circuit board 8. The housing 10 has cavities 18 with diametrically opposed slots or channels 19 that hold a respective contact 20 having arms 42 that receive a respective lead 4 of the package 2.

Taylor fails to show or suggest an electrical circuit assembly having a socket that exerts a biasing force against the electrically conductive connecting element to hold a substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device. Also, Taylor fails to show or suggest an electrical circuit assembly that is free of any containment structure between the substrate and the integrated circuit device surrounding the at least one socket. Imasu et al. fails to add these elements to the disclosure of Taylor.

Imasu et al. disclose a microchip 12 electrically connected to a printed wiring board 2 by stud bumps 13 formed on an electrode pad 12a of the chip. The stud bumps 13 have a two-stage bump structure with a base bump 13a formed on each electrode pad 12a and a stack bump 13b stacked on the base bump.

Imasu et al. fail to show or suggest that the stud bumps 13 are received in a socket of any kind, let alone a socket for receiving an electrical conductive connecting element to exert a biasing force to hold the substrate and integrated circuit device in electrical and mechanical connection without the need for a

connector separate from the substrate and integrated circuit device.

Accordingly, claim 38 is submitted as unobvious and patentable over the references of record.

Claims 27-30 now depend directly or indirectly from new claim 38 and are submitted to be patentable over the references of record for the same reasons as claim 38.

IV. Claim 39

New claim 39 is similar in scope as claim 36 but recites that the electrical conductive connecting element comprises a conductive sphere deposited on the circuit device or substrate that is received in the socket. More specifically, new claim 39 is directed to an electrical circuit assembly comprising:

- a substrate having a first electrical connection pad;
- an integrated circuit device having a second electrical connection pad;

- at least one socket attached to one of said first and second connection pads prior to assembly of the substrate and the integrated circuit device;

- at least one electrically conductive connecting element attached to the other of said first and second connection pads prior to assembly of the substrate and the integrated circuit device, the connecting element comprising a conductive sphere deposited on the other of said first and second connection pads;

- said conductive sphere being received in said socket when the substrate and integrated circuit device are assembled such that the at least one socket exerts a biasing force against said conductive sphere to hold the substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device, said assembly being free of any containment structure between the substrate and the integrated circuit device surrounding the at least one socket.

New claim 39 is submitted to be unanticipated by and patentable over the references of record, and in particular Taylor, in that whether considered alone or in combination the references fail to show or suggest an electrical circuit assembly having all of the features recited in new claim 39.

As set forth above for claim 36, Taylor discloses a socket 6 comprising a housing 10 for interconnecting an electronic package 2 to a circuit board 8. The housing 10 has cavities 18 with diametrically opposed slots or channels 19 that hold a respective contact 20 having arms 42 that receive a respective lead 4 of the package 2.

Taylor fails to show or suggest an electrical circuit assembly having a socket that exerts a biasing force against the electrically conductive connecting element to hold a substrate and integrated circuit device in electrical and mechanical connection without the need for a connector separate from the substrate and integrated circuit device. Also, Taylor fails to show or suggest an electrical circuit assembly that is free of any containment structure between the substrate and the integrated circuit device surrounding the at least one socket.

For these reasons, new claim 39 is unanticipated and patentable over Taylor and the other references of record.

Claims 32-35 now depend directly or indirectly from new claim 39 and are submitted to be patentable over the references of record for the same reasons as claim 39.

V. Claim 40

New claim 40 corresponds to original claim 2 rewritten in independent form. Claim 2 was rejected solely on the basis of depending from a rejected base claim.

Accordingly, claim 40 is submitted as patentable over the references of record.

VI. Claims 41-44

New claim 41 is directed to an electrical circuit assembly comprising an integrated circuit device in electrical and mechanical connection via the interengagement of at least one electrically conductive connecting element with a socket. The socket comprises two resilient members configured for attachment to electrical connection pads on one of the circuit device and substrate. The socket is adapted to receive electrically conductive connecting elements of the assembly such that the resilient members exert a biasing force to hold the substrate and circuit device in electrical and mechanical connection. More specifically, claim 41 recites an electrical circuit assembly comprising:

a substrate having a first electrical connection pad with a connection surface;

an integrated circuit device having a second electrical connection pad with a connection surface;

at least one electrically conductive connecting element non-releasably attached to the connection surface of one of said first and second connection pads prior to assembly of the substrate and the integrated circuit device;

at least one socket comprising at least two resilient members having pad connection portions directly and non-releasably attached to the connection surface of the other of said first and second connection pads prior to assembly of the substrate and the integrated circuit device, said pad connection portions extending generally parallel to said connection surface of the other of said first and second connection pads and being attached in face-to-face contact with said connection surface;

said at least one socket being adapted to receive said at least one electrically conductive connecting element when the substrate and integrated circuit device are assembled such that the at least two resilient members of the socket exert a biasing force against said at least one electrically conductive

connecting element to hold the substrate and integrated circuit device in electrical and mechanical connection.

New claim 41 is submitted to be unanticipated by and patentable over Pass, Taylor and the other the references of record, in that whether considered alone or in combination the references fail to show or suggest an electrical circuit assembly having all of the features recited in new claim 41.

Specifically, the references of record fail to show or suggest an electrical circuit assembly having at least one socket comprising at least two resilient members having pad connection portions that are directly and non-releasably attached to the connection surface of the connection pad of one of the substrate and integrated circuit device and that extend generally parallel to the connection surface such that the pad connection portions are in face-to-face contact with the connection surface.

Accordingly, claim 41 is submitted as patentable over the references of record.

Claim 42 depends from claim 41 and recites that each of the two resilient members is formed from a flat metal strip. The references of record fail to show or suggest this feature. Accordingly, claim 42 is submitted as patentable for this additional reason.

VII. CONCLUSION

In view of the foregoing, consideration and allowance of claims 2-21, 23-25, 27-30, and 32-44 as presently presented is respectfully requested.

A check in the amount of \$336.00 is enclosed to cover the fee for a one-month extension of time for responding to the Office action and the additional claim fee. No additional fee is believed to be due. The Commissioner is authorized to charge any fee deficiency or credit any overpayment to Deposit Account No. 19-1345 in the name of Senniger Powers.

Respectfully submitted,



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